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ABSTRACT

An analysis of group social relationships through an interpersonal perception point of view is presented. Each member of a group is asked to make a judgment concerning the social distance between each pair of members in the group. The Carroll and Chang scaling model, called Individual Differences Scaling (INDSCAL), which assumes that individuals use similar dimensions in making distance judgments between stimuli, but that individuals may differentially weight these dimensions in making their judgments, was applied. Data were collected from a group of 8 fraternity men who had volunteered for sensitivity training. At the second meeting hour of the training group, each group member was asked to fill out a Cattell 16 P.F. personality inventory and a FIRO-B Interpersonal Inventory, and to make four unidimensional forced rankings of all group members on: degree of openness, degree of empathy, degree of trust, and degree of gregariousness. The pair compa ison judgments of social distance were analyzed by the INDSCAL computer program. Results are given in tabular form. (CK)

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QUANTITATIVE MEASUREMENT OF SOCIOMETRIC RELATIONSHIPS THROUGH MULTIDIMENSIONAL SCALING[1]

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QUANTITATIVE MEASUREMENT OF SOCIOMETRIC RELATIONSHIPS THROUGH MULTIDIMENSIONAL SCALING

Traditional sociometric analyses have focused on the use of sociometric choice data (friendship, working partner choices, etc.) to determine the structure of social relationships within the group, i.e., identification of outcasts, cliques, mutually attracted dyads, most popular members, etc. These sociometric choices have been analyzed by a multitude of methods: graphic methods (Moreno, 1953), tabular methods, matrix manipulation and matrix multiplication methods (Forsyth and Katz, 1946; Festinger, 1949; Harary and Ross, 1957), factor analytic methods (Procter, 1953; Hubbell, 1965; McRae, 1960), and recently by multidimensional scaling methods (Townes, 1970). Although a great deal of valuable information has been gathered by the above methods, the authors feel that with the exception of Townes (1970) none of the methods of sociometric analysis have been able to produce a quantified spatial model of the social relationships between all group members. Even the Townes study, which analyzed converted sociometric choice data by a non-metric multidimensional scaling method (Kruskal, 1964), was plagued with relatively poor solutions.

In the present study the analysis of group social relationships was approached from an interpersonal perception point of view. Instead of focusing on individual choices of friends, work-

ing partners, etc., this research focuses on the group members' perception of the relationships between fellow members and between himself and fellow members. Each member is asked to make a judgment concerning the social distance between each pair of members in the group. By using recently developed multidimensional scaling techniques (Carroll and Chang, 1970), a composite picture of the group social structure in metric distances can be developed with a quantitative indicator of how well this composite picture actually reflects the judgments of social distance made by each group member.

Conceptually, a judgment of social distance is quite different from a traditional sociometric choice paradigm. Not only is a group member being asked to make a judgment of social distance between himself and all other members in the group (different than friendship choice), but he is also being asked to judge the relationship between other pairs of members in the group. Hopefully, this type of task will cause the individual group member to draw on behaviorally anchored information such as degree and kind of social interaction. Also, a perceptual judgment approach offers a number of statistical advantages which would facilitate comparisons between members within the group and across groups. The measures are a continuous variable of absolute judgments of distance between pairs of members.

The Carroll and Chang (1970) scaling model called Individual Differences Scaling (INDSCAL) assumes that individuals use simi-

lar dimensions in making distance judgments between stimuli, but that individuals may differentially weight these dimensions in making their judgments. For example, two individuals may make a comparison between cups of coffee on the basis of temperature, sugar content and cream content, but one individual might emphasize temperature in his judgment of similarity (one type of distance judgment), while the other emphasizes cream content. One could think of this as a kind of sensitivity to different dimensions. Analogously, two individuals may use similar dimensions or some similar dimensions in making judgments of social relationships, but differ in the emphasis they place on these dimensions when making their judgments. Stated another way, these two individuals have somewhat different perceptual points of view. Most of the previous multidimensional scaling techniques (Kruskal, 1964; Shepard, 1962) have been unable to take individual differences in perception into consideration when developing the spatial representation (an exception to this is the Tucker and Messick Points of View Analysis, 1963). In earlier scaling models the judgments of a number of individuals have been averaged and then analyzed, therefore masking or averaging out individual differences. Carroll and Chang have provided a solution to this problem (see Carroll and Chang, 1970, for a detailed explanation of statistical methodology). Essentially, their method results in three kinds of information: 1) a composite space of metric distances between the judged stimuli; 2) a measure of "fit" which indicates the degree to

which the composite space reflects the actual judgments of each individual and, 3) a set of weights indicating the emphasis each individual placed on each derived dimension of perceptual judgment.

If the application of the INDSCAL model to perceived social relationships can be shown to reflect to a high degree of accuracy the judgments of the individuals (meaning that most individuals perceive the social structure along similar dimensions), then attempts can be made to determine what these dimensions are or to determine what personality characteristics or traits covary with the perceived distances between individuals or to measure the effect of experimental manipulations.

One of the important advantages of a multidimensional scaling approach to interpersonal relationships (based on distance judgments) is that the dimensions on which the judgments are made are not designated a priori by the researcher. The individual subjects are allowed to use their own dimensions of perception. Bruner and Tagiuri (1954) noted the need for "systematic studies devoted to an analysis of the categories used by ordinary people in every day life for describing other people ...." Jackson, Messick and Solley (1957) introduced a multidimensional scaling approach to the study of person perception in response to this need. Jackson et al. felt that there were difficulties with an a priori designation of dimensions in relatively unexplored areas. The authors feel that the statements

of Bruner and Tagiuri (1954) and Jackson et al (1957) can be applied to the perception of social relationships among people. There is a need to determine the bases (dimensions) of the perception of social relationships.

It would seem that there are two general classes of variables which may directly and indirectly affect the perception of social relationships. First, there are those more observable aspects of interpersonal behavior which appear to lead most directly to a judgment of social distance. Observed behaviors related to the type and amount of social interaction between two members would be in this category. On the surface, it would seem likely that two persons who had been observed interacting in an intimate or friendly manner would be seen as being close in their social relationship. Secondly, there are those variables which are related to personality traits or characteristics of the individuals participating in the social exchange. It is this second class of variables which has traditionally been the focus of studies in the interpersonal attraction research area. Most of these studies have searched for congruent characteristics (the idea that people are attracted to people who are similar to themselves in attitudes, values, etc.). The most well known advocate of the congruency hypothesis is Theodore Newcomb. Although alternative hypotheses are available (such as the complementary hypothesis of Winch, 1958) the present study is limited to the search for congruent variables at least in this phase of the research.

In summary, the present study is oriented toward investigating 1) the efficacy of Individual Differences Scaling in representing perceived social relationships through a multidimensional spatial model and 2) the relationship of personality characteristics to derived dimensions of social perception.

METHOD

Subjects. Data was collected from a group of 8 fraternity men who had volunteered for sensitivity training at Southern Methodist University. All Subjects were undergraduates at the University at the time of the study.

Procedure. At the second meeting hour of the training group, each group member was asked to fill out a Cattell 16 P.F. personality inventory (Cattell, 1950) and a FIRO-B Interpersonal Inventory (Schutz, 1970). During the same session, each group member was asked to make four unidimensional forced rankings of all group members on: 1) degree of openness, 2) degree of empathy, 3) degree of trust, and 4) degree of gregariousness.

After 15 group meetings, each group member was given a randomized list of member pairs ($\frac{N(N-1)}{2}$ pairs) with the following instructions:

> "The task is to make a judgment, on each pair, as to how close you feel these people are in terms of their relationships to one another. A score of one (1) means that these people are about as close as they can get, and a score of twenty (20) means that they are about as distant as they can get."

RESULTS

The pair comparison judgments of social distance were analyzed by the INDSCAL computer program. This analysis results in five "composite" group spaces or solutions for the total set of group comparisons. Because it is not known how many dimensions it will take to account for the judgments of social distance made by the group members, the program solves the equations for 2, 3, 4, 5 and 6 dimensions. After the "best" configuration (best in a least squares sense) is found for a specific number of dimensions the program takes the distances between group members in that resulting "composite space" and correlates those distances with the actual distance judgments made by each individual. The average of the correlations of "fit" for all group members is taken as an indicator of the accuracy in which a particular solution (2, 3, 4, 5 or 6 dimensions) reproduces the actual distance judgments made by the group members. Figure 1 shows the degree of "fit" for 2, 3, 4, 5 and 6 dimension solutions in terms of squared average correlation coefficients. A 2-dimensional solution "accounts for" an average of 55% of the variance of the actual judgments; a 3-dimensional solution "accounts for" an average of 66% of the variance; a 4-dimensional solution, 73%; a 5-dimensional solution, 76%; and a 6-dimensional solution, 80%.

Although each of the 5 different solutions can be analyzed

further, it is preferable to select a solution which has minimum dimensionality but with maximum explanatory value (high "fit"). This is similar to deciding on the "correct" number of dimensions in factor analysis or the most efficient number of predictor variables in a multiple regression analysis. One can usually increase the variance "accounted for" by adding more dimensions or variables, but you would be complicating the solution without much actual gain in prediction or explanation. In this study a 3-dimensional solution was chosen as being the "best" solution by a decreasing gain rule.

Table 1 shows, for the 3-dimensional solution, the dimension weights for each individual in the group and the correlations between each person's actual distance judgments and the distances between group numbers in his modified "composite space". These weights are similar to regression weights in that they modify the individual's distance judgments so that a "composite space" is developed which has a maximum "fit" to the distance judgments of each individual. The addition of weights in the solution is tantamount to stretching or shrinking the dimensions in accordance with the individual's perceptual point of view.

Figure 2 is the 3-dimensional "composite space" obtained through the INDSCAL analysis. The placement of each group member in the multidimensional space reflects the perceived social relationships in the group. As shown in Figure 1, this 3-dimensional "composite space" of perceived social relationships ac-

counts for an average of 66% of the variance in the actual distance judgments or an average correlation of .82.

In Table 3 are shown the correlations between the various personality variables and the projections of the individuals on the 3 dimensions of the group "composite space".

FIGURE 1

AVERAGE SQUARED CORRELATION COEFFICIENTS BETWEEN THE 2, 3, 4, 5 AND 6 DIMENSION "COMPOSITE SPACES" AND ACTUAL JUDGMENT OF SOCIAL DISTANCE

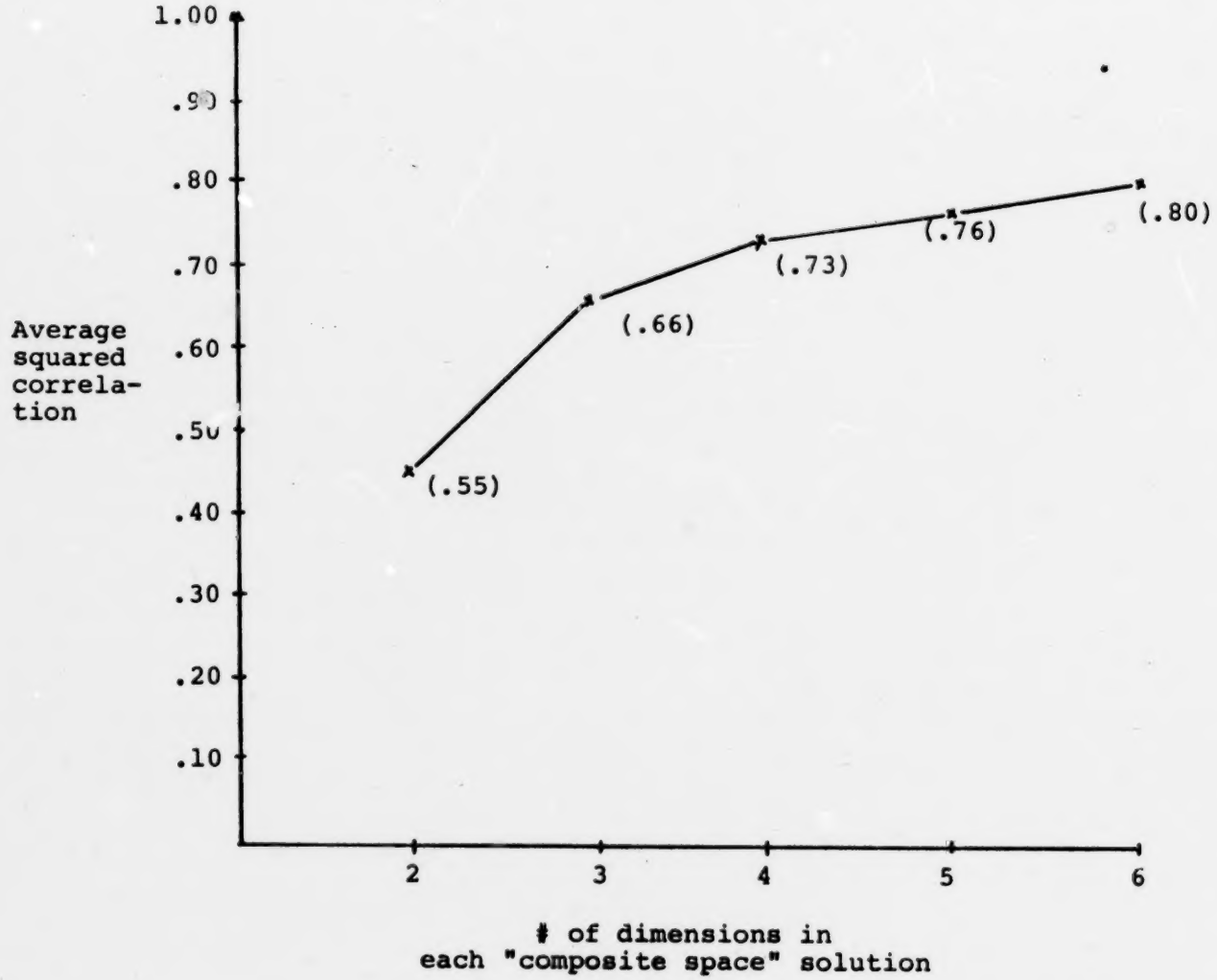

TABLE 1

DIMENSION WEIGHTS FOR
EACH GROUP MEMBER

	Dimension 1	Dimension 2	Dimension 3
Group Members	Weights	Weights	Weights
1) Bob	.48	.23	.60
2) Jim	.78	.20	.04
3) Pete	.57	.57	.24
4) Steve	.84	.16	.16
5) Clyde	.72	.36	.29
6) Bill	.64	.12	.31
7) Abe	.67	.41	.15
8) Mike	.24	.30	.71

CORRELATIONS BETWEEN DISTANCES
DERIVED BY SCALING AND THE ORIGINAL
DISTANCE JUDGMENTS MADE BY
EACH GROUP MEMBER

1) Bob	.81
2) Jim	.81
3) Pete	.85
4) Steve	.86
5) Clyde	.87
6) Bill	.72
7) Abe	.81
8) Mike	.82

$\bar{X}$ correlation = .82

FIGURE 2

LOCATIONS OF GROUP MEMBERS IN THE "COMPOSITE SPACE"
REFLECTING PERCEIVED SOCIAL DISTANCE

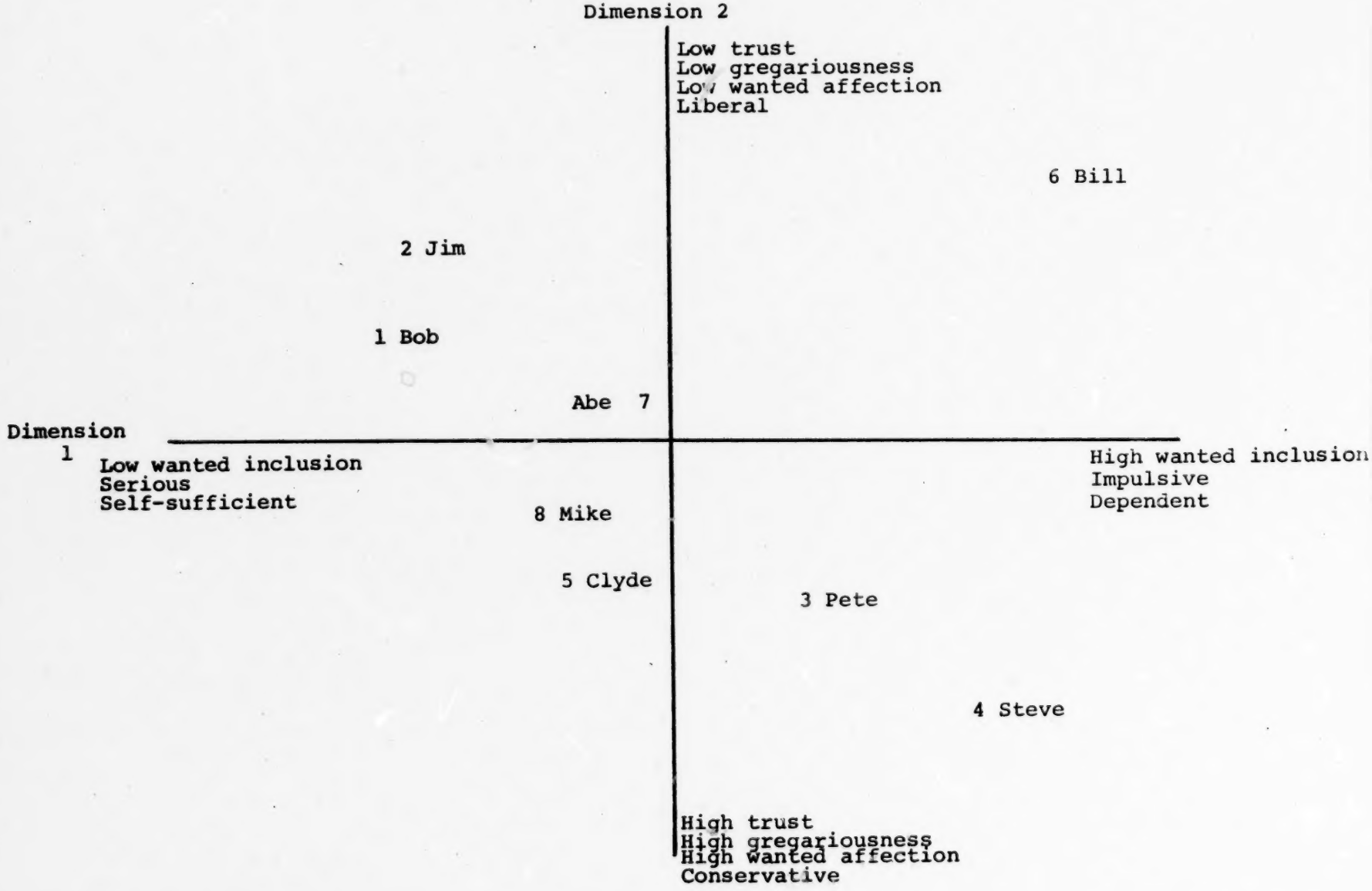

FIGURE 2 (Cont'd)

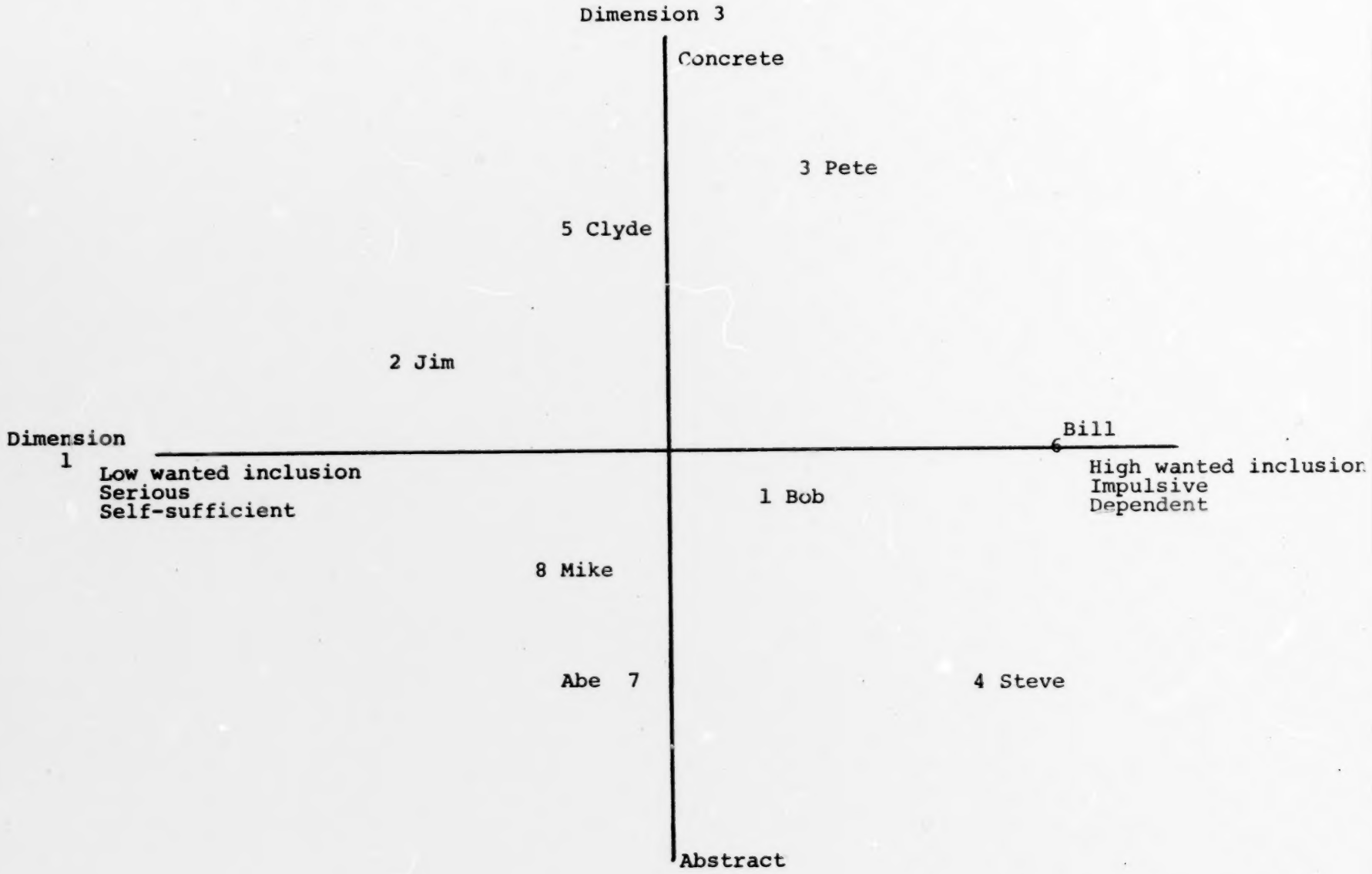

FIGURE 2 (Cont'd)

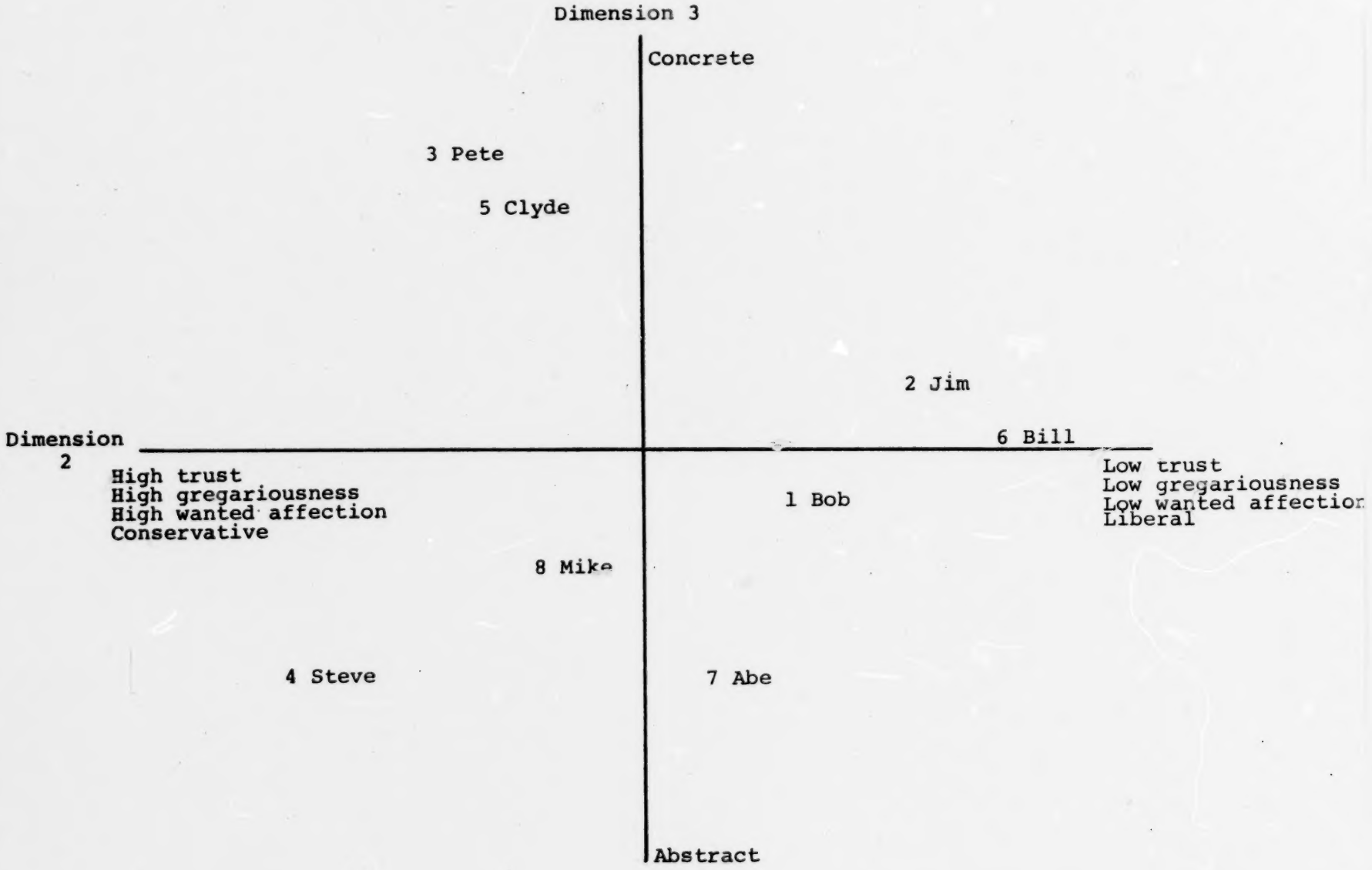

TABLE 2

CORRELATIONS BETWEEN INDSCAL DIMENSIONS AND

PERSONALITY VARIABLES

PERSONALITY VARIABLES	INDSCAL DIMENSIONS		
UNIDIMENSIONAL RANKINGS	1	2	3
Openness	-.516	-.353	-.076
Empathy	.249	-.002	-.409
Trust	.248	-.633*	-.136
Gregariousness	.472	-.697*	-.337
FIRO-B			
Expressed Inclusion	.494	-.253	.053
Expressed Control	-.358	.403	.253
Expressed Affection	.341	.204	.165
Wanted Inclusion	.668*	-.353	-.048
Wanted Control	.602	-.424	.031
Wanted Affection	.425	-.732*	-.013
16 P.F.			
Reserved-Outgoing	.295	-.275	.415
Concrete-Abstract	.014	.215	-.694*
Emotional-Stable	-.555	-.456	-.410
Submissive-Dominant	.046	-.107	.448
Serious-Impulsive	.709*	-.546	.114
Expedient-Conscientious	.048	.556	-.193
Shy-Bold	-.428	-.229	-.315
Self-reliant-Clinging	.151	-.170	-.282
Trusting-Suspicious	.365	-.053	.570
Practical-Imaginative	.098	-.178	-.505
Forthright-Calculating	-.095	.457	.030
Self-assured-Apprehensive	.458	.098	-.060
Conservative-Liberal	.121	.705*	-.183
Dependent-Self-sufficient	-.700*	.144	-.286
Impulsive-Controlled	.086	-.065	-.297
Relaxed-Tense	-.110	.388	.442

* $P < .05$

DISCUSSION

The results of the application of Carroll and Chang's (1970) Individual Differences Scaling model to the analysis of social distance judgments gives strong support for the use of the model in developing a spatial model of perceived relationships within a small group. The "fit" of the derived group structure (composite space) to the actual distance judgments supports the hypothesis that individuals perceive social relationships within the group similarly although there are individual differences in the weighting of the dimensions making up the judgment of social distance. As shown in Figure 1, a 3-dimensional solution accounts for an average of 66% of the variance of the actual judgments of social relationships. A visual inspection of Figure 2 easily reveals those persons who are perceived as being close in their relationships and those who are not. Not only does scaling model present the data in graphic form, but quantitative scores representing the coordinates of each group member are available for further research.

The attempt to obtain correlates of the dimensions of social perception (Table 2) resulted in at least one significant correlation for each dimension, although further research by Hollweg (research in progress) indicates that these dimension interpretations are not stable across different groups. Al-

though these dimension correlates seemed to make "sense", the authors feel that other behavioral dimensions based on something like a Bales interaction analysis design might provide more stable results. One could think of the obtained correlates as being related to underlying causal factors in interpersonal attraction, but until further research is done this type of interpretation would be a rather severe inferential leap.

In summary, the authors feel that Individual Differences Scaling has important applications in interpersonal attraction and group cohesiveness research. The advantages of an INDSCAL approach to sociometric analysis are several: 1) the model results in a spatial configuration of perceived social distances which is not dependent upon a diagrammer's subjective judgments; 2) the model is a rigorous and quantitative approach; 3) the distances between individuals in the spatial configuration are on a metric scale and can be used for a variety of research applications and 4) the data is relatively quick to obtain and the computer print-outs are easily read.

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